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PRACTICAL NAVIGATION.

Self-instruction in the Practice and Theory of Navigation. By the Earl of Dunraven, Extra Master. Two volumes. Pp. xxv + 354 + 388. (London: Macmillan and Co., Ltd., 1900.)

THE science of navigation, apart from the practical art of seamanship, stands on a very curious footing. Based mainly on mathematical results, it presents probably the only, certainly the most conspicuous, instance of the adaptation of pure science to practical ends. As a consequence nautical astronomy, or those portions of it which are indispensable to navigation, has been systematised to such a pitch of perfection that a mechanical system has been substituted for a reasoning process. Many regard this result with satisfaction as a triumph of scientific simplicity, and pride themselves on the production of navigators capable of producing a definite practical result with the least possible expenditure in training. Perhaps it would be unjust to say that this view is shared by the Earl of Dunraven, the author of the latest book on the theory and practice of navigation. But he is not prepared to throw his known experience as a sailor and his great popularity as a successful yachtsman on the side of those who would make the Board of Trade Regulations more stringent, and would demand from applicants for the various certificates some proof that they have acquired more than a rule-of-thumb acquaintance with the various methods and formulæ that they will have to put into practice. The effect, if not the object, of his book is to show with how little knowledge one may pass the Board of Trade Examinations, and be legally entitled to assume positions of enormous responsibility. But admitting that it is desirable to give the practical seaman every chance in the examination room, and that the accurate solution of a problem is the only point to be regarded, is it easier to teach once for all the ordinary methods for the solution of a spherical triangle, or to burden the memory with a variety of rules which are available only for the solution of the particular family of problems to which these rules have been adapted? Take, for example, the case of the determination of an hour angle from the observation of an altitude in a known latitude. The candidate for a certificate, taught on the lines that Earl Dunraven approves and encourages, has to remember first of all a series of rules about declination and latitude being of the same or different names; then he has to write certain quantities down in a particular order, perform sundry acts of legerdemain, take out four different logarithmic functions of angles, add them up, and is landed in a quantity which his lordship calls "the log. of the hour angle." It is the log. sine squared of half the hour angle, but this is a detail, and if one happens to possess the particular table in which some obliging genius has given this quantity, with argument hour angle, the work is done and it may be, so far as the result is concerned, satisfactorily. To trust to the memory rather than the rigorous process of demonstration is a plan Earl Dunraven thinks admirably adapted to meet the difficulties introduced by "a wet, slippery, and tumbling deck" and the inconveniences "of a dimly-lit cabin, full of confusion and noise." We fail to perceive the particular advantages of this system, but would express any doubts on this point very modestly, for the author speaks from an actual experience, which we can very inadequately apprehend.

But if our methods of teaching are as far asunder as the poles, it is impossible to escape the influence of the cheerful, breezy style in which the book is written—a model for those who attempt to substitute teaching by written description for oral explanation. The author appears to be sitting at the same table with the student, giving him of his best, and actually pushing him through the examination. If any one has failed to satisfy the examiner that he is competent to do "a day's work," let him take Earl Dunraven for his guide, and he will become fully persuaded of the easiness of the problem, rather than of its difficulty, and will pass the ordeal with success.

The author supposes his pupil to be conversant with the multiplication table, but with practically nothing else, so he gives first a chapter on arithmetic, followed by one on the application of logarithms; the theory is dismissed in a page, and of this short summary the student is told "don't bother to read it unless you have a mind to." This is the keynote of the whole book, only those problems which can have an immediate practical significance, or can be broached in the examination room, are pressed on the student's notice. But to make amends for the lack of theory, on the practical side, the detail is very full and complete. From logarithms we pass to the description of the instruments used at sea, and so arrive at the "sailings" and that troublesome problem of the "day's work," which proves such a stumbling block for so many aspirants for certificates. At this point the author thinks it time to introduce a little algebra and trigonometry, though he advises only extra masters to read it, and we must admit that it contains some hard things, and that we should have some difficulty in solving some of the simple equations proposed by following the rules laid down for our guidance. The author is not seen at his best in these chapters, which are better taught in the schoolroom than on the ship's deck. Tides and charts, so far as their investigation and construction are needed for the examination room, are fully explained. The first volume concludes with the solution of simple problems connected with the determination of latitude, longitude, and azimuth.

We cannot get very far into the second volume without some knowledge of spherical trigonometry, and here, again, we do not find the chapters devoted to this subject altogether satisfactory. Spherical trigonometry covers a very small but well recognised subject of inquiry, and can without much difficulty be made complete. The methods are simple and easily applied, except in one point, and that is the determination of the quadrant in which the various arcs fall. Earl Dunraven has not much assistance to offer on this vexed point. He pins his faith to Haversines, and as a rule keeps free from the employment of auxiliary angles. In this he is no doubt well advised, for the advantages of the method so long insisted upon in elementary treatises are by no means so apparent in actual work. Through the intricacies of the ingenious method known as Sumner Lines, Earl Dunraven conducts us with care, especially dwelling on the use of the

various tables that have been introduced to facilitate the process and hasten the result. After one or two further applications of spherical trigonometry, we are brought face to face with that curious survival, known as a Lunar Distance, and we are quite sure that the author did some violence to his sense of practical utility when he devoted so many wearisome pages to the consideration of this obsolete problem. In the examination room of the Board of Trade, the thorny difficulties of "clearing the distance" may exercise a wholesome effect on the extra master, whose fate it is to attack this problem, and induce him to acquire a greater knowledge of nautical astronomy than he would otherwise do; but we imagine in the great majority of cases the applicant endeavours to forget all about the intricacies of the problem as soon as he is possessed of his qualifying "ticket." The skill of the mechanician has done much to remove the necessity of the ingenious device, but the rapid transit of vessels from port to port, and the numerous time signals in known longitudes, give to the mariner Greenwich Time more accurately than it was ever determined by the method of lunar distances. But for some reason known only to the authorities, an acquaintance with the method is demanded, though the necessary facility in manipulating the sextant cannot so well be required. The whole process affords an interesting case of the resources of analysis outrunning in accuracy the observations to which it is applied.

"Problems," says Earl Dunraven, "will be given you in the examination room on the infernal subject of magnetism and deviation," so he has much to say about the coefficients A to E. To many, we are afraid these coefficients will remain a matter of intricate manipulation, carrying no definite meaning; but if they follow the author's guidance, they ought to issue triumphantly from the examination ordeal. His rules are admirably arranged, and, from a purely mechanical point of view, leave nothing to be desired. We could have wished that the theory had been a little fuller, but we remember, a little regretfully, that the author's object is not to teach magnetism, but to pass the reader or student through an examination of a strictly limited character. We cannot but think that the book is eminently calculated to effect this object. Admirably printed, well and lavishly illustrated, furnished with numerous examples and written in a free and easy, but lucid style, we should imagine that this work is destined to become the most popular book on the subject, and that it will be the one guide and text-book to which the young officer will apply, to help him to meet and defy the terrors of Her Majesty's examiners. W. E. P.

THE CULTIVATION AND PRODUCTION OF COFFEE.

Le Café, Culture—manipulation—production. Par Henri Lecomte, Agrégé de l'Université, Docteur es Sciences, &c. Pp. vi + 342. (Paris: Georges Carré et C. Naud, 1899.)

COFFEE in its various commercial aspects, whether from the point of view of the planter, the broker, the retail dealer, or the consumer, has from time to time commanded a great deal of attention. Occupying as it does a large and extended area of cultivation within the tropics, and being an important branch of industrial culture in many of the British possessions, as Jamaica, Ceylon, Southern India, and Borneo, it is but reasonable to expect that treatises on the cultivation, best means of improvement of yield and quality, prevention of disease, &c., would be numerous. In the English language many such works are available, and if this be so, bearing on a culture which though large and important is small in comparison with that of Brazil, Central America, Mexico, Java, and Sumatra, we might also expect to find a large number of books in the languages of the nations to which these extensive coffee growing countries belong.

The work before us is the latest contribution to the French literature of the subject, and extensive as that literature is and for the most part carefully worked out, M. Lecomte's handbook will be a useful and valuable addition not only for its arrangement, but also for the concise character of the information given and the various items of intelligence regarding production in the several countries referred to and exports therefrom.

The first chapter is devoted to the early history of the coffee plant. The botany of the genus *Coffea* is treated of in the second chapter occupying twenty-five pages, and is illustrated by a figure of the so-called Arabian coffee (*Coffea arabica*) in flower and in fruit, and a figure is also given of *C. stenophylla*, the tree which furnishes the wild coffee of Sierra Leone, as well as of the new species from the Congo, *C. canephora*, Pierre. In the enumeration of species given in this chapter thirty-three are referred to, prominence, of course, being given to *C. arabica* and *C. liberica*, the two most important coffee yielding species. The best varieties of *C. arabica* cultivated in various parts of the world are also enumerated. Referring to *Coffea stenophylla* the specific name of which, by the way, is spelt with a capital initial letter, the author gives the following interesting account of it: In 1894 some plants of this new species were received at the Royal Gardens, Kew, from Sierra Leone, and these plants produced flowers in 1895. Seeds were afterwards sent to most of the English colonies where it was thought the plant might flourish. In Ceylon, however, the results have not been satisfactory; but in Dominica, Jamaica, and Trinidad, the case has been different. In the Botanic Garden of Port of Spain, Trinidad, there are some fine fruiting examples of this tree quite free of disease. The author further regrets that this coffee has not yet been introduced into the French colonies. On the climate and elevation suitable for the success of coffee plantations the great coffee-growing country of Brazil has the first consideration. The remaining chapters are devoted to the consideration of soils, the choice of seeds, transplanting, manures, shade trees, &c. The use of simple diagrams showing the different positions in which the coffee plant and its shade trees may be placed will be found useful, as will also the list of trees suitable both for shade and shelter, amongst which we notice such well-known trees as *Albizzia Lebbek*, *A. stipulata*, and *Exythrina indica*.

On the subject of harvesting or gathering the crop it is pointed out how extremely variable in the period of ripening its seeds the plant is in different countries. Thus in Cuba, Guadaloupe, and other islands of the Antilles, the harvest commences in August and is carried on through